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## ELECTRIC LIGHT AS A DIAGNOSTIC AND THERAPEUTIC AGENT.<sup>1</sup>

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THE attempt to illuminate the less accessible cavities of the human body had its origin as long ago as the beginning of the present century. Bozzoni, in 1805, first conceived the possibility of throwing light into the bladder, but without much success. In 1853 Desormeaux exhibited the first endoscope before the Paris Academy of Medicine. Julius Bruck, of Breslau, is said to have first employed the platinum loop as a source of illumination for medical work. In 1867 he exhibited a stethoscope designed to assist in examining the rectum and bladder. These old instruments were cumbersome and inefficient, but Nitze and Leiter have constructed a cystoscope which has achieved remarkable success.

The use of the electric light in medicine now covers a much larger field and has become an important aid in diagnosis. By it the dentist can detect spots of decay in the tooth which without it would escape his observation. The nose and throat specialists are able to search the minutest recesses, while the physician who is in doubt regarding certain diseased conditions of the stomach and abdomen, may literally study his obscure cases in a new light.

In 1885 Dr. Louis J. Lauterbach, of Philadelphia, published an account of the use of the incandescent electric light in examinations of the eye, ear, and throat. He recommended for illumination of the ear the use of a

<sup>1</sup> Abstract of committee report read before the American Electro-therapeutic Association, September 27, 1894.



tiny lamp placed close to the speculum and enclosed in a shield having a small circular opening in it.

In 1890, Theodor Heryng was able to illuminate the antrum of Highmore by using a five-volt incandescent lamp attached to a tongue depressor. He was able in more than thirty cases to diagnosticate latent empyema without exploratory puncture, and this diagnosis was corroborated by the subsequent removal of the pus.

About two years ago Davidsohn called attention to the value of illuminating the eyeball by an incandescent lamp in the mouth. Quite recently Burger has claimed that luminous sensations in the eyeball were far more distinctive tests than illumination, as a very feeble light was sufficient to excite the subjective sensations.

On November 1, 1893, the writer had the pleasure of demonstrating this point to a number of physicians by introducing an incandescent lamp into the mouth. On the lamp being illuminated the pupils of the eyes were seen as blood-red apertures, and it was also shown that if the person so illuminated cast his eyes upward at an angle of 45° he could discover the same phenomenon. Mr. N. Stevenson has called attention to the curious fact that when light is thus introduced the pupils do not contract.

Dr. D. Braden Kyle, of Philadelphia, has recently introduced some improvements for examining the nasal cavity. The essential feature of his method is the placing of the lamp within the post-nasal space so that the parts are seen by direct instead of by reflected light. He also recommends that the lamp be protected with a cap of aluminum, by the aid of which it can be used continuously for thirty seconds without inconvenience from heat. This lamp was furnished by Charles Lentz, of Philadelphia.

Within the past few months Dr. Charles W. Caldwell has published an article in which he has considered the subject of transillumination of the mastoid cells as a means of diagnosis of mastoiditis interna suppurativa.

The examination must be made in a perfectly dark room. When the lamp is inserted well into the external auditory meatus and the current turned on, the healthy mastoid is illuminated with a red glow, extending from the apex to the lateral sinus and to the limits of the cells above. By placing the lamp on different parts of the mastoid the limitation of the cells and the position of the lateral sinuses may be accurately mapped out, and pathological conditions demonstrated if present. If there is a purulent condition in the cells this portion will appear dark. Comparison with the opposite healthy side renders the diagnosis of pus in the mastoid cells complete, whether or not the usual symptoms are present.

The same observer has also described a method of transilluminating the accessory sinuses of the nose, by which he was able to detect a large mucous polypus by its translucency, higher refraction, and globular form, which concentrated the light, and increased the brilliancy of the illuminated area.

Dr. Chevalier Jackson, of Pittsburgh, has also practised transillumination of the nose successfully for some time past. His method differs somewhat from that previously described, as he uses a fifty-candle-power lamp and a hollow silvered glass rod.

As an instance of the great clinical value of electric illumination in diseases of the nose and throat a case of tubercular laryngitis has been reported in which no tubercle bacilli could be found in the expectoration, but on passing an applicator deeply down into the passages under the guidance of a brilliant electric light, some secretion was found, which on removal proved to contain innumerable tubercle bacilli.

The work of Dr. Max Einhorn in connection with the transillumination of the stomach is well known. His "gastrodiaphane," first described in November, 1889, consists of a soft rubber stomach tube containing wire conductors and having a small Edison incandescent lamp mounted at the gastric end of the tube. By its aid the

examination is performed so quickly that there is no danger of the lamp becoming too hot, especially as the water in the stomach (swallowed by the patient just previously) exerts a cooling action upon it. Dr. D. D. Stewart, in the *Medical News* for February 18, 1893, speaks of the value of gastrodiaphany as follows: "The actual utility of gastrodiaphany over other methods of outlining the stomach lies especially in the application of the diaphanoscope to the differentiation of gastrophtosis and gastrectasia, as by it the determination of the site of the lesser curvature is far more readily made than by inflation."

Theodor Heryng has succeeded in transilluminating the anterior walls of the vagina. With the help of a Ferguson speculum he was also able to insert an electric apparatus into the rectum and so transilluminate the posterior wall of the vagina as far as the posterior fornix.

With reference to apparatus, it is a matter for regret that much of the intended experimental work has not been done on account of the great difficulty experienced in securing suitable lamps.

The W. F. Ford Surgical Instrument Company have furnished a lamp for transillumination of the frontal sinuses, also one for the transillumination of the antrum of Highmore, and a head lamp. The Galvano-Faradic Manufacturing Company have furnished a small mouth lamp for general use. The use of a lamp has also been secured for the transillumination of the bowel, known as Heryng's lamp, and a lamp for the transillumination of the pelvic tissues devised by myself. These lamps have all been personally tested, with the following results:

Ford's head lamp requires  $10\frac{1}{2}$  volts and 1 ampère, and gives 3-candle power. For use with a street current, it should be placed in circuit with one 16 and one 24-candle-power lamp. Ford's lamp for the transillumination of the frontal sinuses requires 8 volts and .8 ampère and gives about 2-candle power. For use with street current two 16-candle-power lamps should be placed in

circuit. Ford's antrum lamp requires 8 volts and .8 ampère and gives a little over 2-candle power. For use with the street current, one 16 and one 24-candle-power lamps are needed. The lamp supplied by the Galvano-Faradic Company, requires  $5\frac{1}{2}$  volts and .8 ampère and gives a little over 1-candle power. For use with street current it requires two 16-candle-power lamps in circuit. Heryng's lamp for transillumination of the bowels has a glass shield or cap over it with an attachment to a fountain syringe so that water is allowed to flow about the lamp and also through the terminal opening into the bowel itself. It requires 9 volts and .7 ampère and gives a little over 2-candle power.

The lamp for the transillumination of the pelvic tissues, devised by myself, requires 32 volts and .8 ampère, giving about 8-candle power. It was a 20-candle-power lamp, but as it passed through a chapter of accidents, it is at present only an 8 candle power, but will be replaced shortly by one of 20-candle power. This lamp is also a water-lamp, the water flowing in and around the lamp and distending as well the folds of the vagina by a device similar to that described in my new water electrode.<sup>1</sup> The lamps variously used and the results obtained from them have already been indicated in the report. The Edison lamp or condenser for direct illumination of the different cavities of the body has also been tested. It is particularly suited to positions in which the direct rays of light may be used and is also satisfactory where the light has to be reflected.

So far as the transillumination of the bowel is concerned, nothing has as yet been done. I have made, however, a number of observations in transillumination of the pelvic tissues. As a result of these I have found that wherever there is morbid material, either in the form of exudative matter or abnormal growths, as fibroid tumors, sarcoma, etc., the tissues of the anterior pelvic and abdominal walls are not transilluminated but remain abso-

<sup>1</sup> See MEDICAL RECORD, August 25, 1894, page 252.

lutely black. In the abnormal conditions which have been examined the pelvic cavity has been pretty well filled, so that there has been no transillumination. Of course with the morbid material on one side only, the other side should be transilluminated. In so far as I have done any work in this direction, I regard transillumination of the pelvic organs of rather doubtful utility. The conditions can be much more accurately determined by means of the educated finger than by any candle power of electric light that has yet been used.

I have been able to obtain translucency of the tissues within two inches of the umbilicus, but have demonstrated nothing save the course of blood-vessels.

The foregoing statements give a fair idea of the use of electric light in diagnosis, but they by no means compass all the methods by means of which electric light is helpful in therapeutics. One of the recent adaptations is known as the electric-light bath, and is based on the proposition that the properties of electric light are similar to those of sunlight. By means of a suitably constructed cabinet, patients are subjected to the rays of a number of incandescent lamps. The temperature can be regulated by passing the current through a resistance coil and may vary between  $90^{\circ}$  and  $150^{\circ}$  F., with a result equivalent to a combined light and vapor bath. The skin is browned as if by sun-burn and the effect is claimed to be most salutary.

The writer has had placed in her hands for use an apparatus furnished by a manufacturer of Newark, which is worthy of attention as a means of experimental work. It is a cabinet with an arc light arranged in front of a large tin reflector which can be raised or lowered at will. This and a lamp with a very strong lens and reflector for localization of the rays of light are the only apparatus which have been placed at my disposal. It is impossible, therefore, to say which form of apparatus is best; but owing to the production of ozone by the arc light I would give it the preference. No observations

have yet been made as to the efficacy of the light used through glass or similar substances, nor have investigations been attempted which would enable me to arrive at any conclusion as to possible difference in therapeutic effect between electric light and solar light.

Turning now to a consideration of the effect of light on living organisms we find that plants have been forced into rapid growth by exposure to the rays of the electric light. M. D'Arsonval has made many investigations on the effect of both sunlight and electric light on various bacterial growths. He found that cultures exposed to the white rays were not colored while those exposed to the red rays had developed pigment. He also expressed the opinion that light exerted a more powerful influence over bacteria than ozone or even oxygen.

Dr. H. Marshall Ward in a paper read before the Royal Society showed the effect of light on bacilli from the Thames, and found that in all cases both solar and electric spectra exerted no perceptible action whatever in the infra-red, red, orange, or yellow region, while all the bacteria were injured or destroyed by the rays from the blue or violet spectrum. The intervention of a thin piece of glass resulted in cutting off a large proportion of the effective rays. The most distinctive rays, *i.e.*, those at the end of the blue and beginning of the violet, were to some extent effective even after reflection from the inner faces of a quartz plate covering the film, and the glass on which it was supported. This investigator goes on to say that these results evidently suggest that the naked arc light may prove to be a very efficient disinfecting agent for use in hospital wards, railway carriages, and other places where the rays could be projected directly on the organisms.

Theodor Geisler in 1892 found no qualitative difference between sunlight and electric light, only a quantitative difference. In the course of some experiments on the typhoid bacillus, he found the most decided effect was produced by the rays from the violet end of the spectrum.

P. A. Khmelevsky, of St. Petersburg, after prolonged experiments, concluded that both solar and electric light have an undoubted inhibitory influence on the growth of microbes.

Klebs-Loeffler has discovered that diffused light does not prevent the development of cultures of diphtheria at ordinary temperatures or at a temperature as high as 95° F., but that sunlight arrests this development, and after an exposure of several days sterilizes bouillon. This bactericidal power of light toward the bacillus of diphtheria is due almost exclusively to the rays of greatest refraction, those at the other end of the spectrum having little or no action of this kind.

Some years ago experiments were made with Jablochkoff candles in the Paris sewers, with the result that considerable purifying action was noted.

In 1881(?) Mr. Harold P. Brown, E.E., of New York, while using Brush arc lamps for lighting the basement of a store in Chicago, noted that within an hour after turning on the current, the odor from the closets, which at first was very offensive, became entirely neutralized.

The writer, who has an arc-light apparatus in her office such as has been described, made the following observation on a recent excessively hot day. The refuse barrels which had accumulated over Sunday in the basement and had not yet been removed Monday morning, emitted a very unpleasant odor, which filled the office. The arc light was turned on and the writer left the room for half an hour. On her return she found that every evidence of odor had disappeared and that the air seemed perfectly pure, while in another part of the house which was not near enough to be affected by the light, the odor still persisted as before. This action was undoubtedly due to the ozone.

In an article in *The Medical Week* for August 17, 1894, Dr. R. L. Bogles gives some interesting facts regarding the influence of solar rays on the skin and concludes that some other principle must be at work beside

heat. Some observations of M. Charcot tend in the same direction. The phenomenon appears to be due to the action of the chemical rays in the ultra violet end of the spectrum. Mr. H. B. Hewetson, in the *British Medical Journal* for 1893, cites five cases in which eyes became inflamed after watching the operation of electric wiring by the arc light, unless the observer was protected by a shield of thick ruby glass. It was found that the skin of the face and neck would become tanned and would peel off just as if it had been exposed to the rays of the sun. This was evidently not due to heat but to the chemical rays.

M. Gautier has recently investigated a curious phenomenon, namely, that substances which have been submitted to the action of electricity or which have been exposed to the direct rays of the sun, are in a peculiar state of excitement which renders them much more active as regards one another than are the same substances prepared by the ordinary methods of the laboratory.

Such being the admitted facts, one is prepared for the assertion that electric light may be made a potent therapeutic agent. Dr. Gatchkowsky, St. Petersburg, 1892, reports twenty-seven cases, chiefly of rheumatic and neuralgic pain, which he had quickly cured by the electric light, and Stanislaus von Stein also reports good results.

Few observations have yet been made by the writer as to the therapeutic value of electric light. Something, however, has been done, as the following particulars will show. In one case of cervico-occipital neuralgia of great severity, coupled with supra-orbital neuralgia, the application of the electric light was found to be exceedingly grateful to the patient and resulted in relief from pain for several hours. In a case of intense pain in the roots of the cervical cord, an extension of neuritis, the only way the patient was able to get sleep, without hypnotics, was by having an electric lamp placed directly over the cervical cord. In this instance, however, it is believed that the heat only produced this grateful result.

The following experimental observation is reported somewhat at length :

J. C—, twenty-one years of age ; suffering from anæmia and enuresis. The electric arc light bath was given for twenty minutes. The patient was placed upon a stool within the cabinet with the entire body exposed to the rays of light, special attention being paid to localizing it at the lumbar and sacral plexuses. The treatment was entirely experimental, but with the expectation of, at least, improving the nutrition. The writer felt willing to undertake it, as she was confident of being able, later on, to cure the enuresis by long percussive static sparks. The patient had suffered from nocturnal enuresis as far back as she could remember. Menstruation was established at seventeen and was perfectly regular. All the conditions were normal save that the patient was decidedly anæmic, and suffered from facial acne : the pupils were always dilated, and there was a tendency to constipation, the bowels often moving but once in two days—rarely two or three days consecutively. The wet nights were slightly variable ; she would sometimes go in summer two or three nights without trouble, but rarely for this time in winter. In all, sixteen treatments were given, extending over a period of one and a half months, three times weekly. Careful examinations of the urine were made at first, and the pulse, temperature, and skin were carefully watched. Thirteen observations were taken of the temperature and pulse. In eleven instances the pulse dropped, and it was always of better volume after the bath. In two instances the pulse remained unchanged but with improved volume ; while in every instance (thirteen times) there was a rise in the temperature of from .1 to .8 degrees. The skin always became moist under the applications, and during the last treatments perspiration was very profuse. There was a general sense of well-being expressed by the patient after each application. Soon after coming under treatment the bowels became regular, and there was no trouble during the time she

was under care, nor since then, a matter of nearly six months, excepting for a few days at one time after discontinuance of treatment, when very much hurried making preparations for leaving the city, she was slightly constipated. The urine was analyzed from time to time, and showed a steady increase in the amount of urea eliminated. The patient gained a pound and a half during the first two weeks, and since that time has gained seven pounds more, and is in better health than for several years. The temperature of the bath varied on different days, being affected by the outside temperature, but ranged from 90° to 100° F. The patient always left the office feeling much better. No drug of any sort was given or allowed the patient during the time she was under observation.

Arrangements have just been made with a dermatologist to have observations made as to the value of arc light in parasitic skin disease, and, in fact, to carry out a systematic series of scientific experiments bearing upon these points. The writer is well aware that the value of one or two experimental cases is open to question, but under the special circumstances already referred to has thought well to mention the few cases quoted, wishing it to be distinctly understood that she considers the investigation very incomplete in its present stage.

It is interesting to note that Dr. Dawson Tyner, of London, commenting upon the well-known treatment of goitre by smearing the part with red iodide of mercury ointment and then exposing the surface to direct sunlight, suggests that the effect is due to the power of iodine to cut off the visible rays of the spectrum. The fact that red iodide is the more efficacious points in this direction, for it would serve to transmit the heat rays only. In this way the part is subjected to the full blaze of the calorific rays without the vibrations of its molecules being altered by the visible rays. If this theory be correct we could expose diseased parts to sunlight or to a fire after the application of iodine. May not this suggestion give

us a valuable hint in connection with the use of the electric-light bath.

And now, after studying this novel and interesting subject until we have begun to form some adequate conception of the potency of light, we are confronted with the rather startling announcement, from no less a physicist than Professor Dolbear, that there is no such thing as light—that there are no peculiar waves which can be called light. In proof of this assertion he describes a method of taking a photograph of an object in absolute darkness by means of the ether waves set up by working an electrical machine. We have already seen how similar are the effects of sunlight and the electric light, but lest there should still be a lingering doubt in the minds of some individuals regarding this point, that distinguished experimenter, Nikola Tesla, comes forward and produces a faint glow of light in a dark room with alternating currents of 800,000 voltage, by means of atmospheric vibrations to such an extent that the phenomenon would no longer be electricity, but light !

68 MADISON AVENUE, NEW YORK, October 30, 1894.



